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(19)(CA) **CANADIAN PATENT** (12)

(54) Lining of Bore Holes

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(57) 5 Claims

SC 224

ABSTRACT OF THE DISCLOSURE

The invention relates to the lining of bore holes with cement or the like by apparatus designed to spray cement directly on to the raw face of the hole. Such apparatus in accordance with the invention comprises a spray head, means to drive the heat through the hole and means for delivering cement to the head characterized in that the head has an annular chamber into which cement is fed and from which colloidal cement is fed in an annular ring to a rotatable spray disc or arm which is arranged to distribute the cement substantially evenly over the internal surface of the hole. The annular feed enables even spray to take place whilst avoiding problems associated with axle feeding.

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THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. Apparatus for spraying cement on the walls of a bore hole or the like comprising an annular chamber into which cement is fed from a supply source and an annular outlet for exhausting cement from the chamber, and a rotatable spray disc arranged to receive cement from the annular outlet, the spray disc being adapted to distribute the cement substantially evenly over the internal surface of the bore hole wherein a pump or mixer is provided in the annular chamber to remix the cement just before it is exhausted therefrom to ensure that colloidal cement is sprayed from the rotatable spray disc, the rotatable spray disc further comprising a support plate and a number of equally spaced radially extending spray bars mounted on the plate, a second wider bar being mounted on top of at least the outer end portion of each spray bar.

2. Apparatus as claimed in claim 1 wherein the rotatable spray disc is driven by an air motor mounted on the top of the apparatus.

3. Apparatus as claimed in claim 1 wherein a pin is positioned traversely across channels formed on each side of each spray bar between the top bar and the plate.

4. Apparatus as claimed in claim 1 in which the spray head unit, is supported in the hole on eight wheels arranged in four pairs, two at one end and two at the other, the wheels of each pair being positioned on opposite sides of the apparatus and the wheels of one pair at each end being supported on axes at right angles to those of the wheels of the other pair at that end.

5. Apparatus as claimed in claim 4 wherein the radius of the wheels is greater than or equal to the depth of normal pot holes or irregularities to be found in the wall of the bore hole.

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IMPROVEMENTS IN AND RELATING TO THE LINING OF BORE HOLES.

This invention relates to the lining of bore holes. It is desirable to line bore holes or the like with for example cement by a process or device which is under remote control thus avoiding the necessity of an operator actually being present in the hole. One example of this is the lining of bore holes connecting underground roadways in a mine. Such holes are conveniently about 1.5 meters in diameter and 200 meters deep and it would be dangerous for anyone to move down such holes manually to apply a cement or concrete lining.

There have been several attempts to solve this problem. Firstly it has been proposed to use pre-formed liner sleeves which are grouted together in situ. This however has led to very difficult problems in alignment and securement.

Secondly, it has been proposed to provide shuttering and to cast cement between the shutter and the raw face of the hole. This has led to problems of pressure build-up at the bottom of the hole and of proper alignment and positioning of the shuttering members and as well as the undesirably long time taken by the cement to set.

The third approach has been to try to spray cement directly on to the raw face of the hole. This has led to difficulties in providing an effective remote controlled cement spray apparatus which can deliver

cement substantially evenly over the wall of the hole at an acceptable feed rate using 'colloidal cement' i.e. cement into which water is mixed under high shear conditions giving good hydration of cement particles.

The present invention is concerned with the third approach namely the use of remote controlled cement spraying apparatus.

Such cement spraying apparatus has to have means for spraying the cement equally around its circumference so that the hole is evenly coated as the apparatus moves through the hole.

The normal way of achieving even spraying would be to supply the cement through an axially arranged rotatable tube, the lower end of which carries the nozzle head. Problems, however, have been found to arise with such an arrangement, firstly because the axial tube which is rotated at high speed tends to heat up causing the cement to cure in the pipe during spraying constricting the flow of grout. Secondly it has been found that the delivery tubes for the colloidal cement and the air pipe for an air motor to rotate the tube, tend to get tangled up with the haulage ropes for the apparatus if, for example, the apparatus moves around the circumference of the hole during passage therethrough.

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Apparatus for spraying cement on the walls of a bore hole or the like which solves these problems and which, in accordance with the invention, comprises an annular chamber into which cement is fed from a supply source and an annular outlet for exhausting cement from the chamber, and a rotatable spray disc arranged to receive cement from the annular outlet, the spray disc being adapted to distribute the cement substantially evenly over the internal surface of the bore hole wherein a pump or mixer is provided in the annular chamber to remix the cement just before it is exhausted therefrom to ensure that colloidal cement is sprayed from the rotatable spray disc, the rotatable spray disc further comprising a support plate and a number of equally spaced radially extending spray bars mounted on the plate, a second wider bar being mounted on top of at least the outer end portion of each spray bar.

The annular feed which enables even spraying to take place, avoids the problems associated with axial feeding whilst at the same time enabling a pump or mixer to be provided in the annular chamber which is a highly desirable (although not essential) feature of a spray apparatus in accordance with the invention. The mixer acts to remix the colloidal cement mix just before spraying to produce well hydrated and plasticised cement for spraying.

According to a second feature of the invention, the rotatable part of the spray head is preferably driven by an air motor mounted on the top of the apparatus.

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Channels are thus formed on each side of each spray bar between the top bar and the plate and in use, a thin film of cement is fed into these channels at the inner end of the spray bars from the annular chamber, the cement flowing continuously out along the channels to be discharged from the ends thereof against the wall of the bore hole.

It has been found that if a pin is inserted traversely across the channels this acts to cause the cement to be discharged in a desirable spray pattern e.g. conical.

The support for the spray head unit is preferably provided with eight wheels arranged in four pairs, two at one end and two at the other, the wheels of each pair being positioned on opposite sides of the apparatus, and the wheels of one pair at each end being supported on axes at right angles to those of the wheels of the other pair at that end so that if one wheel enters a pot hole or the like in the wall of the hole the other wheels will act to continue to hold the head centrally in the hole. It is desirable that the radius of the wheels be greater than or equal to the depth of the usual pot holes or irregularities in the bore hole wall.

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The invention will now be further described by way of example with reference to the accompanying drawings in which:

Figure 1 is a section on the center line of a preferred embodiment of spray apparatus in accordance with the invention,

Figure 2 is a plan view to half scale, of the apparatus illustrated in Figure 1,

Figure 3 is a detailed sketch view of the spray bar unit,

Figure 4 is a view of the support frame illustrating the drive wheel system, and

Figure 5 is a plan view of Figure 4.

Referring to Figure 1 the spray head unit comprises a framework comprising upper and lower support plates 2, 4 connected by bolts 6.

A spray head unit generally indicated at 8, is connected to a drive shaft 10, the shaft being rotatably mounted in bearings 14, on the two support plates with its lower end being positioned beneath the bottom plate 4.

The upper end 12 of the drive shaft carries a toothed wheel 16 driven by an air motor 18 through a toothed belt 20 and wheel 22 carried by the drive

shaft of the air motor. The drive arrangement is such that the drive shaft and spray head may be rotated at around 3000 r.p.m. depending on the application.

The portion of the drive shaft 10 extending below the bottom support plate 4 carries pump blades 24 which rotate within a chamber 26 formed between upper and lower plates 28, 30, the plates being carried by bolts 32, from the support plate 4.

The outer wall 34 of the chamber is supported between by the plates 28, 30.

A colloidal mixture of cement and water is fed into the chamber 26 through an inlet 36 at a rate of about 1 to 2 cubic metres per hour. The colloidal cement within the chamber is remixed by the blades 22 and a balanced pressure is maintained within the chamber. The inlet pressure at the inlet 36 is higher than the pressure generated by the pump blades 32 in chamber 26, so that the cement mixture is able to enter the chamber and it then tends to escape above and below the blades. Above the blade there is a labyrinth seal which effectively prevents cement from escaping but below the blades there is a passage indicated at 38 through which well mixed colloidal cement may flow evenly all around the inside of lower plate 30 into a passage 40 alongside a spray bar 42. A number of

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equally spaced spray bars 42 are attached at intervals around a support plate 44 to extend radially outwardly above the plate. The plate 44 is connected to a boss 46 driven by the main shaft 10. The outer end portion of each spray bar 42 has a top bar 48 secured by bolts 50 so as to overlie the spray bars 42 as illustrated in Figure 3 leaving channels of about 10 milimetres in height and about five milimetres deep on each side to receive the colloidal cement mixture being fed out from the annular chamber 26.

When the spray bars 42 hit the colloidal cement which is delivering under pressure from impeller 24 rotating in the mixing chamber 26 through passage 38, the bars, which are being rotated at high speed, in effect slice off some of the cement grout which is then caused by centrifugal force to flow over the vertical faces of the bar 42 between the plate 44 and top bar 48 out towards the periphery of the plate.

At the outer end of each bar a traverse pin 52 is secured, against which the outwardly flowing cement engages and which acts to cause the cement to be sprayed out from the end of the bars in a conical pattern around the perimeter of the head and against the wall of the hole. As an example a 6 milimetre pin will give an 80 milimetre spread in a 1.5 metre diameter bore hole. The pin is preferably of a type such as a Roll pin or "Seloc

Dowel* which may be readily replaced when worn.

It will be appreciated that the apparatus can be very readily cleaned merely by undoing the main nut 54 from the bottom of the mainshaft 10 allowing the boss 46, plate 44 to be removed and cleaned. Also releasing bolt 32 allows removal of bottom plates 30, chamber 34, impeller 24 and top plate 28 for easy cleaning.

It will be seen that the outer end of the plate 30 and the corresponding inner end of the bars 48 are shamfered at 56.

In use the apparatus is designed to be hauled through a bore at a rate of about 1 meter per minute which is intended to produce a sprayed layer of cement on the wall of the hole of about 5 millimeters in thickness.

Referring to Figure 4 the spray head unit is supported from a support framework generally indicated at 60 carrying four pairs of wheels 62(a) and (b), 64(a) and (b), 66(a) and (b) and 68(a) and (b) respectively. As can be seen with reference to Figures 4 and 5 the wheels (a) and (b) of each pair are positioned on opposite sides of the framework 60 to engage opposite sides of the bore hole generally indicated at 70.

The pairs of wheels 62 and 64 are situated at

* - Trade-mark

the upper end of the support framework as seen in Figure 4 and the pairs of wheels 66, 68 are located at the bottom end of the framework. The planes of the wheels in the pair 62 at the top of the framework and hence their axes are located at right angles to those of the pairs of wheels 64 and the same arrangement is present with the pairs of wheels 66, 68 at the bottom of the frame 60.

The axes 72 of the wheels are carried at the end of support legs 74. The legs are pivotally mounted about pivots 78 carried by brackets 80, 82 extending out from the framework 60. The wheels are urged outwardly away from the framework by means of pneumatic pistons/cylinders 84 connected both to the brackets 74 and pivotally connected at 86 to the framework. The cylinders 84 of the wheel supports for the two wheels for each pair are connected pneumatically so that the pressure urging each wheel of a pair, outwardly is equal. This has the advantage that if for example one wheel, say wheel 62(a) as shown in Figure 4, falls into a pot hole or "breakout" in the side of the hole the pressure within the strut 84 providing the outward urge for the wheel 62(a) reduces causing a corresponding reduction in the force urging the wheel 62(b) outwardly. Thus the wheel 62(b) does not have any

significant unbalanced force tending to move the frame off the centre line of the bore hole. Indeed the arrangement of the four pairs of wheels is such that the framework and hence the spray head can move smoothly up the bore hole whilst at the same time retaining the axis of the spray head unit substantially aligned with the axis of the bore hole.

The wheels preferably have a radius which is equal to or larger than the depth of any pot hole or depression which is likely to be found in the wall of the hole. In this way even if one wheel enters a depression the other wheels will act to hold the unit central until the wheel within the depression in effect rides out therefrom. The engagement of the wheels on the wall prevent turning of the unit.

It is found that this is preferable to an arrangement in which the spray unit is mounted on sledge members biased outwardly to engage the walls of the hole.

In this case one has to exercise considerable outward pressure on the sledge members to stop the unit turning, and this pressure against the surface of the wall tends to cause the upward movement of the unit to be erratic.

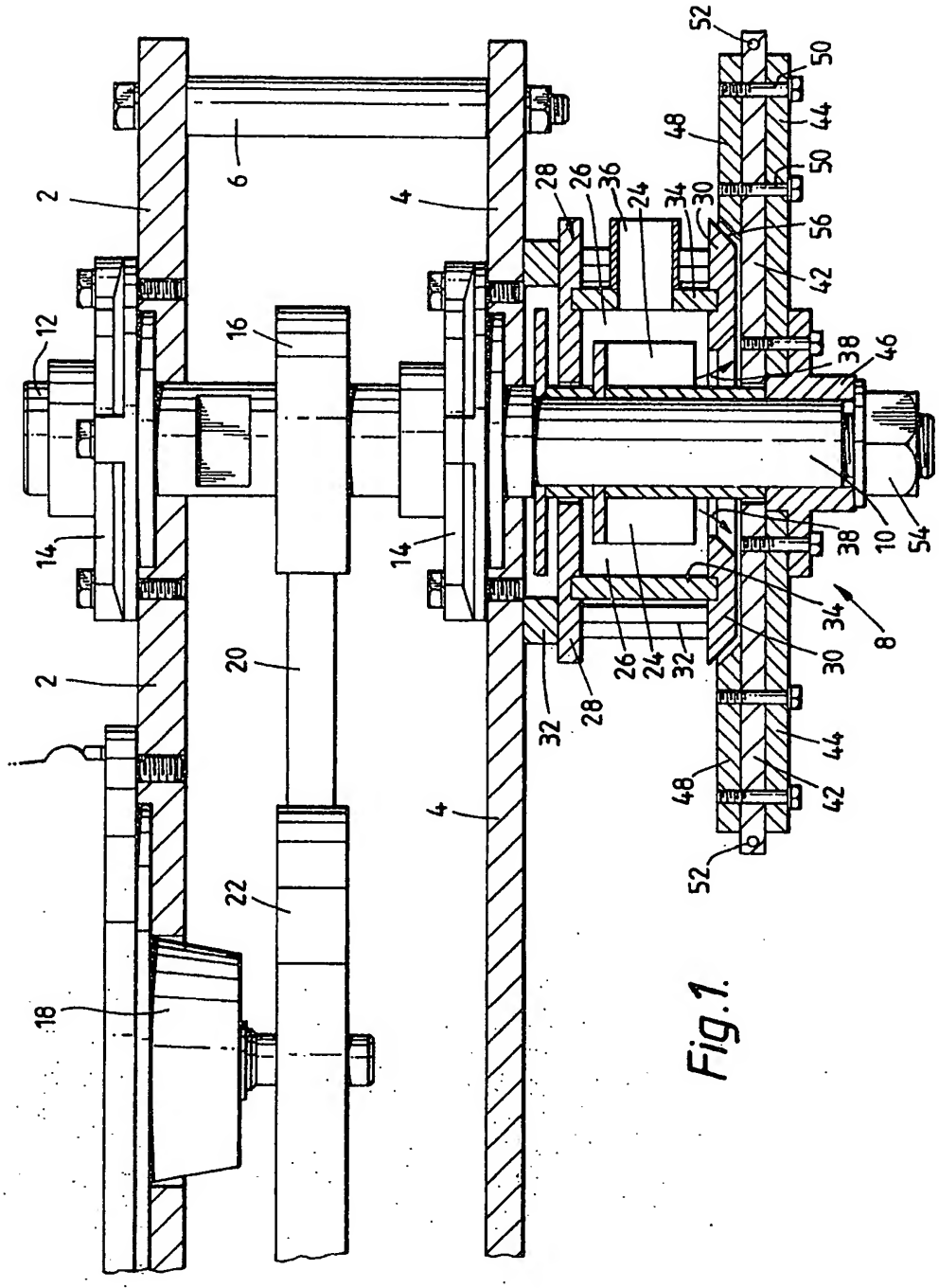


Fig. 1.

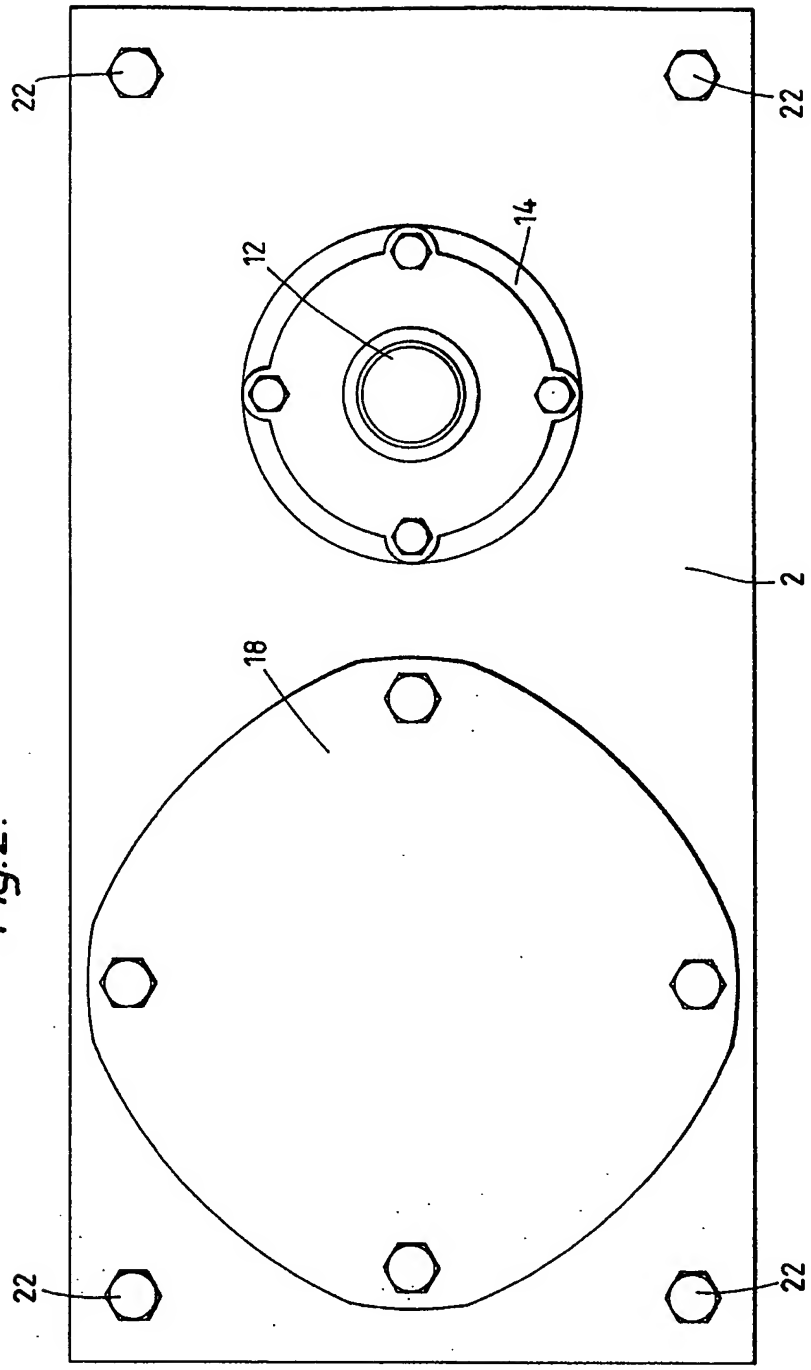


Fig.2.

Fig.4.

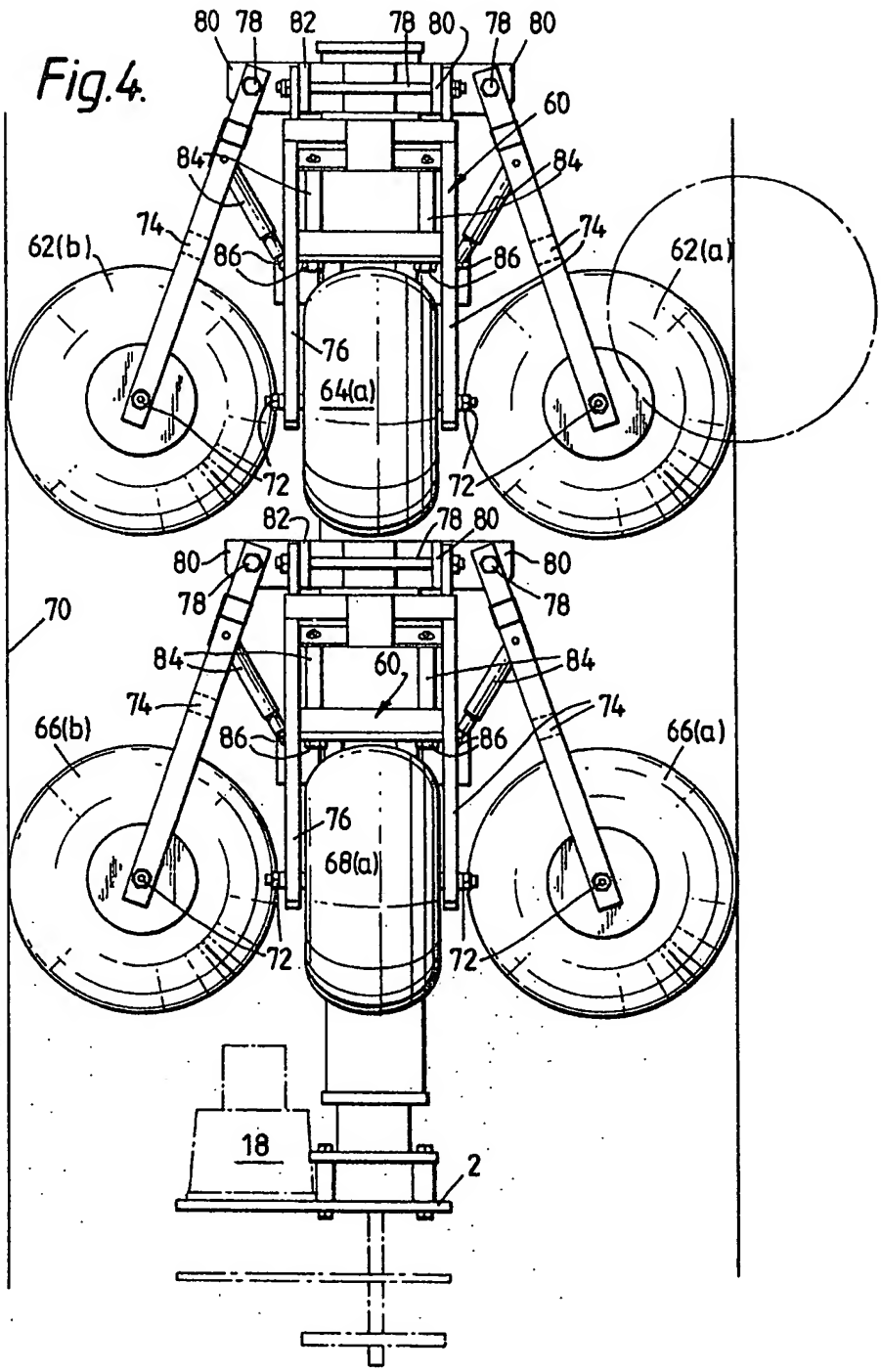


Fig.3.

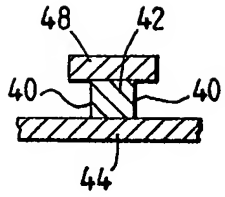
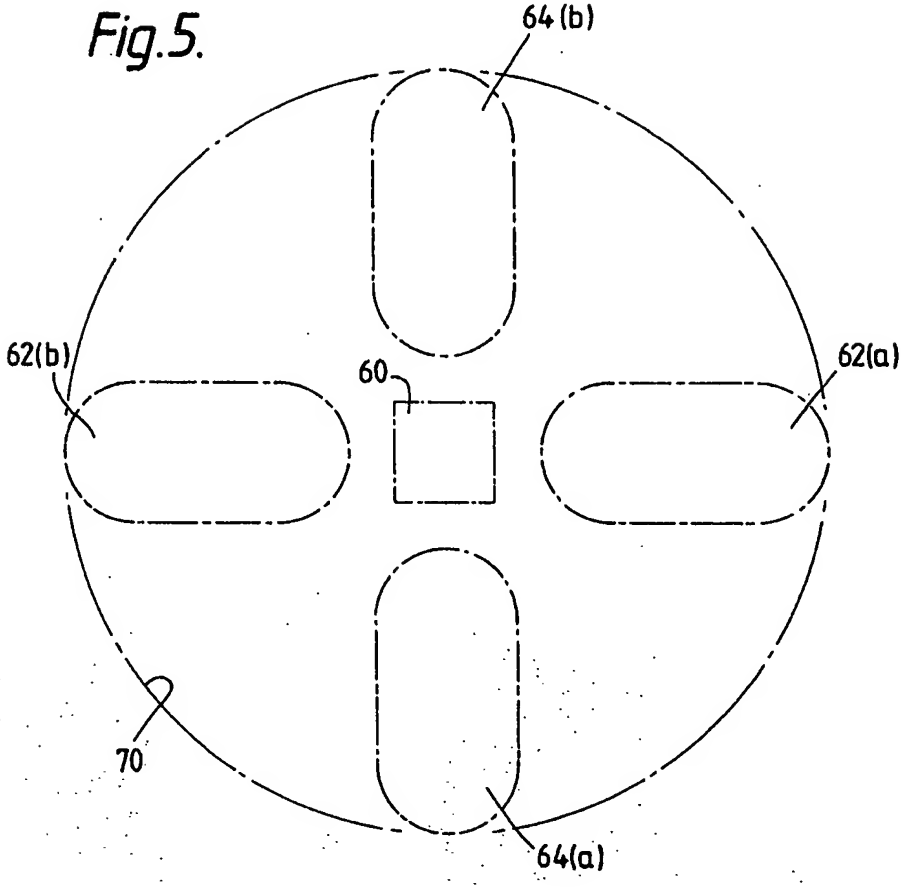


Fig.5.



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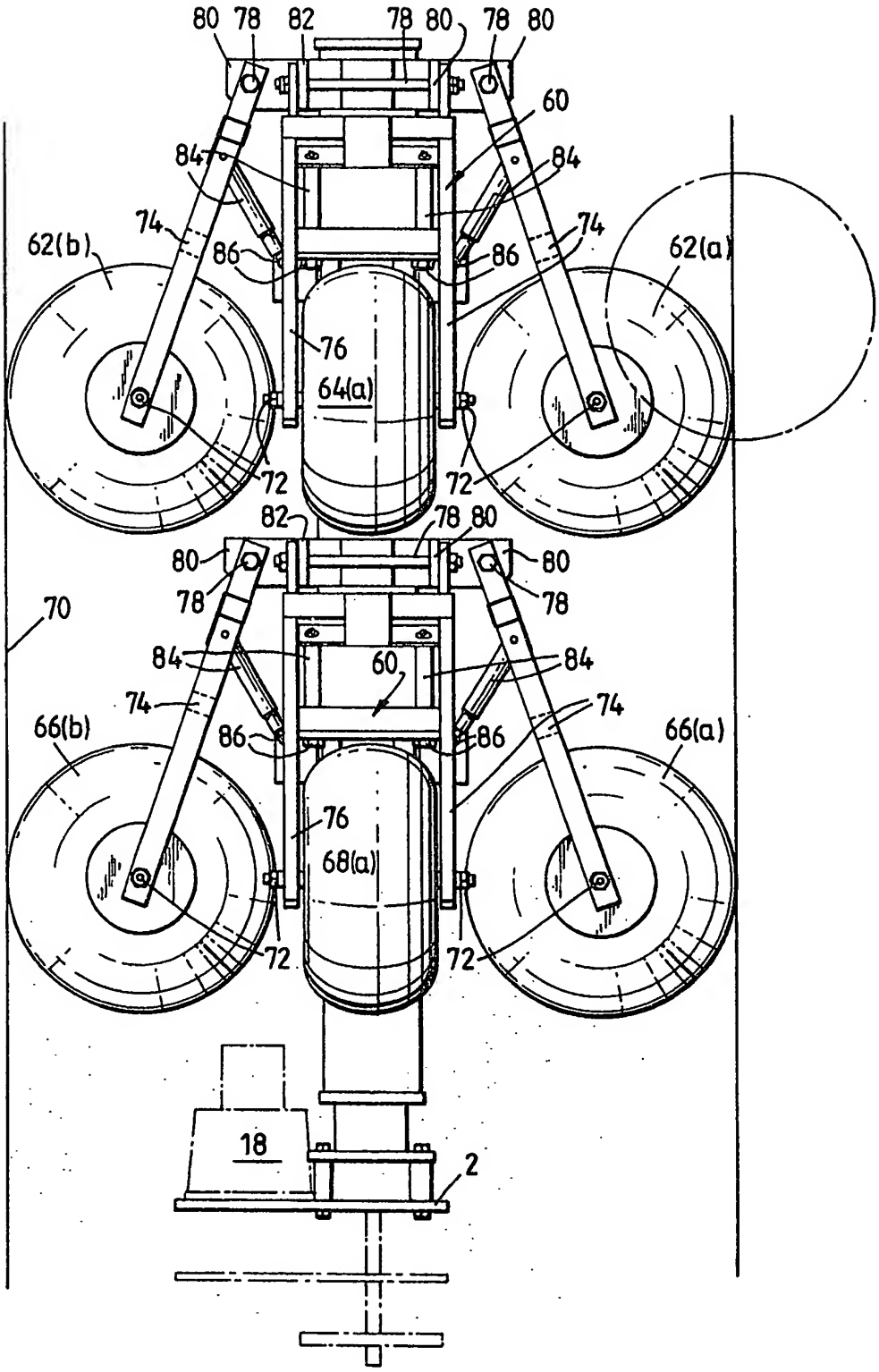
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